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Light and Lighting

Vol. XLII.—No. 3 March, 1949 Price - One Shilling

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Mine Lighting

NO one who has once been exposed to the typical luminance in coal mines questions the need for better lighting, especially at the coal face. It has long been considered that one of the most cogent reasons for improving mine lighting is that the incidence of the very prevalent, and financially costly, "disease known as Miners' Nystagmus" might thereby be reduced. There are good grounds for saying that this "disease" is primarily of emotional origin, though the ocular movements from which it takes its name may be a physiological result of enforced disuse of foveal vision. Better lighting at the coal face should act as a preventive, not only by permitting direct or central vision, but also by promoting a sense of security instead of the nameless fears so easily engendered by impenetrable gloom. Moreover, injuries to mineworkers underground are likely to be less frequent with better lighting. But, besides these considerations, the enjoyment of ample light is as naturally desired by the "hewers of coal" as by the "drawers of water" and all other normal persons.

Illumination Notes and News

I.E.S. Visits to Glass Works

It is announced by the I.E.S. that two visits to glass works have been arranged to take place on Tuesday, May 24. One visit is to the works of Messrs. Chance Bros., Ltd., at Smethwick, and the other is to the Osram-G.E.C., Glass Works at Wembley. The second visit has been arranged for the benefit of London members who may be unable to find the time to go to Smethwick. I.E.S. members are reminded that visits arranged from London are open to all members of the Society. Details of each visit are as follows:—

Messrs. Chance Bros.:—

At this works the party will be able to see rolled plate glass being made by the continuous process, the blowing of glass including hand blowing of lighting ware and pressed glassware including lighthouse apparatus.

The programme for the party travelling from London will be as follows:—

Leave Paddington Station 9.10 a.m.
Arrive West Bromwich 12.13 p.m.
Lunch (at the works) 1.0 p.m.
Tour of the works 2.15-4.15 p.m.
Leave West Bromwich 5.3 p.m.
Arrive Paddington 8.50 p.m.

Osram-G.E.C.:—

This works is engaged on the automatic production of electric lamp bulbs and valve bulbs and machine drawn rod and tubing for fluorescent lamps and other applications in the electrical and medical industries.

The visit will begin at 2.30 p.m. and will terminate in the works canteen for tea at 4.30 p.m.

Applications for places on either of these visits should be made to the Secretary of the I.E.S., 32, Victoria-street, London, S.W.1.

The Next I.E.S. Sessional Meeting in London

At the I.E.S. Sessional Meeting on April 12 two papers are to be presented, (1) on *The Manufacture of Lighting Glass*, by Mr. J. G. Holmes; and (2) on *The Manufacture of Metal Parts for Lighting Fittings*, by Mr. P. Hartill. This meeting will be held at the London School of Hygiene and Tropical Medicine, Keppel-street, Gower-street, W.C.1, at 6 p.m.

These two complementary papers will, no doubt, be of great interest to lighting engineers and should lead to a lively discussion.

Ideal Homes

The 1949 "Ideal Home" Exhibition at Olympia is as full of interest as ever even for those who cannot yet see any possible chance of ever owning a home. One of the exhibition houses was lighted throughout by fluorescent lamps but it is doubtful if these lamps have yet found general acceptance for use in living rooms. Many of the individual items at Olympia were no doubt very well designed, but when assembled in a room to be lived in the effect was not always a happy one.

The I.E.S. Honour Mr. Howard Long

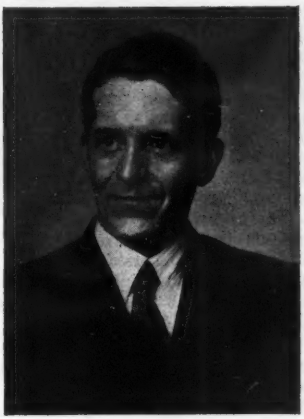
At the I.E.S. Sessional Meeting in London on March 8 the president of the Society announced that the Council had nominated Mr. Howard Long to be an honorary member of the Society.

The president explained that under its constitution the Society were permitted to appoint one honorary member a year up to a maximum of six. There were at present no such members, the distinction having last been held by the late Mr. A. P. Trotter and the late Mr. J. S. Dow. Mr. Waldram also pointed out that honorary members may be chosen from among those who are of acknowledged eminence in some branch of science relating to illuminating engineering or who have rendered assistance in promoting the objects of the Society. Mr. Long's work in promoting the objects of the Society, he said, was well known, he having played a very active part in the formation of I.E.S. Centres and Groups in various parts of the country. In addition to his official visits to the centres during his term as senior vice-president he had over a long period of years shown a great interest in centre affairs, and made a practice of attending local meetings of the Society whenever possible.

Mr. Long, in accepting the honour, said he was deeply conscious of the responsibility to maintain the high traditions of such a distinction. He said that he felt the greatest pleasure and pride, and thanked the council and members of the Society for the very high honour they had conferred upon him.

Mr. Howard Long began his training in the electrical industry before the first World War, in which he served in the R.N.V.R. After a short period as technical assistant with the Holophane Company, he joined Metropolitan - Vickers, where he was manager of the Illumination Department. Seven years later Mr. Long joined the Benjamin Electric, Ltd., serving as manager of the Engineering Department. After a further seven years he was appointed manager of the company's Midland area, an appointment which he has now held for 12 years.

Mr. Long first joined the Illuminating Engineering Society in 1923 at the personal suggestion of Mr. Leon Gaster. He was elected a Fellow in 1941. Service on the I.E.S. Council has extended over two periods as an ordinary member, and two years as a vice-president. He has also served on many I.E.S. committees, and was the first chairman of the Birmingham Centre, which he helped to form. He has also represented the Society on a number of outside committees.

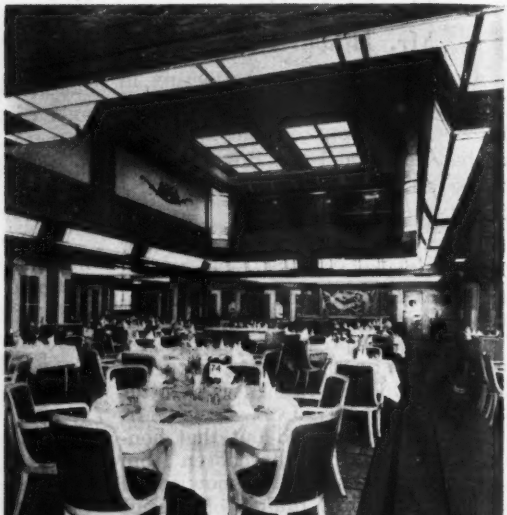


HOWARD LONG

Mr. Long is a member of the Institution of Electrical Engineers, having first joined that body as a student in 1921, and an Associate of the Association of Public Lighting Engineers.

Readers will join with us in congratulating Mr. Howard Long on his so well-deserved honour.

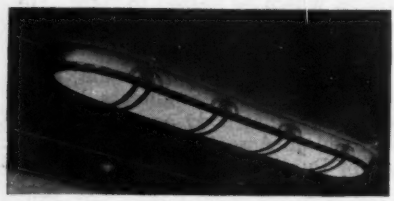
Cold Cathode Lighting in a Liner



Glazed trough and laylight with cold cathode tubing in central well. First-class dining saloon.

On January 23 the Furness Withy liner Queen of Bermuda (22,500 tons) left the Tyne after a complete refitting at the Walker yard of Messrs. Vickers-Armstrongs, Ltd., to resume her sailings between New York and Bermuda. The ship served both as an armed merchant cruiser and troopship during the war, but has now been restored to the luxurious standards appropriate to a service which, with a crossing of 36 hours, offers the sunshine and holiday pleasures of Bermuda to a clientele composed to a large extent of wealthy American business men and their families.

The lighting of the ship has been renewed throughout. One of the outstanding features of the lighting installation is the extensive use of cold cathode fluorescent tubes, the installation being the biggest afloat. Several ships were equipped with cold cathode fluorescent lighting before the war, but on the Queen of Bermuda it is fitted in most of the public rooms and comprises nearly three-quarters of a mile of tubing. Most of the tubes are installed to provide indirect cornice lighting, continuity of light being obtained by turning back the ends of the electrodes so that the lengths of tube butt one against the other. A 230-volt A.C. supply is obtained for the cold cathode lighting from two rotary convertors operating on the ship's 230-volt D.C. system. A third convertor is available as a standby machine.



Decorative ceiling fitting using cold cathode tubes.

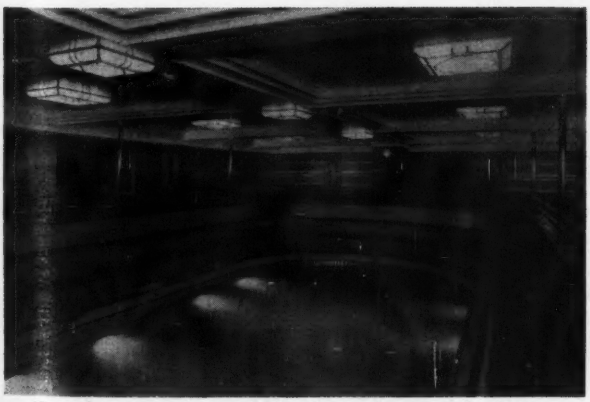
The first-class dining saloon on "D" deck is lighted over most of its area by warm white and gold tubes in cornices to give indirect illumination. Further tubing is fitted in a glazed cornice round the central well, and in the laylight in the centre of the well ceiling. At each end of the saloon is an elongated decorative ceiling fitting containing cold cathode tubes. Supplementary tungsten lamps are enclosed in fittings glazed to ensure harmony between the tungsten lamps and the cold cathode lighting. Other tungsten lamps for window lighting are fitted in concealed silvered glass reflectors on special mountings. The combined effect is a pleasing quality of light which gives a satisfactory rendering of food colours and is also kind to the complexion. The dining saloon foyer

is illuminated by a number of handsome laylights containing tungsten lamps; the metalwork of the laylights is satin silver and the glass medium pink.

A combination of cold cathode and tungsten lighting is seen also in the first-class lounge on "A" deck, where warm white tubes are concealed in a cornice running round the centre part of the room and a number of ceiling panels in the wings. The central portion of the ceiling contains a laylight illuminated by tungsten lamps housed in dispersive reflectors. A striking feature of the lounge decorations is the four ornamental silver-plated standards glazed with pink-tinted glass and containing tungsten lamps, two of these standards being placed one on each side of the stage and one at each side of the recess at the aft end of the room. The lounge is used for cinema and stage shows, and all the lighting, whether cold cathode or tungsten, can be controlled by a motor-operated dimmer. The first-class smokeroom is illuminated almost entirely indirectly from tungsten lamps, but the room contains some handsome decorative lanterns, which are reproductions of three originally fitted in the ship.

First-class library. Combined indirect cold cathode and direct tungsten lighting.

Indirect coloured lighting for the first-class dance space comes from tungsten lamps in a cornice running round the area; there are also three circular tungsten fittings in the ceiling each 3 ft. in diameter with silvered metalwork and peach-tinted glass. Further tungsten lighting is provided by eight semi-circular column fittings, 6 ft. high and 2 ft. wide, four of which face inwards to the dance floor and contain lamps in three colours for the general colour-changing scheme; the other four fittings face outboard and are equipped with white lamps. The outboard areas of the space have indirect cold cathode lighting from warm white tubes in the cornices, supple-



First-class swimming pool showing underwater floodlights.

mented by a continuous run of cold cathode tube in a glazed trough and decorative tungsten ceiling and mirror lights. The whole lighting in the space is controlled by a colour-changing and dimming device.

In the library and writing rooms indirect lighting from warm white cold cathode tubes is blended with tungsten lighting. An ormulu-finished circular fitting 3 ft. in diameter housing tungsten lamps is located in the centre of the library ceiling and is supplemented by rectangular fittings of a harmonising design. Two niches for statuettes in the library are illuminated by concealed cold cathode tubes. The writing tables are individually illuminated by attractive ormulu-finished writing table fittings of special design.

The tungsten lighting in the first-class swimming pool follows the same plan as in the original installation, but the fittings have been redesigned. They are all ceiling fittings with white glass, ranging in size from 3 ft. x 2 ft. 7 in. to 1 ft. 7 in. square, and are finished matt silver. The underwater floodlights have been reconditioned and are now back in service. The lighting fittings in the gymnasium have wired glass, but the design of the fittings, together with the real bronze finish of the metalwork, makes these extremely attractive, despite their having necessarily to be protected from damage.

All the lighting fittings in the first-class entrances have been completely redesigned and the metalwork of the fittings throughout these spaces is finished satin silver, the glass being either plain or reeded. The showcases in the entrances are lighted by reflectors in special mountings.

The design of the lighting fittings for this installation and the cold cathode fluorescent lighting schemes were prepared by the Fittings Design Office and Illuminating Engineering Department of the G.E.C., working in collaboration with Messrs. McInnes, Gardner and Partners, of Glasgow, the decorative architects for the ship.

Personal

Mr. F. M. Hale, formerly with the Street Lighting Dept. of Glasgow, has now taken up an appointment in the Street Lighting Section of the Ministry of Transport, London. Mr. Hale was at one time at the N.P.L., Teddington.

The Colour of Fluorescent Lamps

A paper on this subject was presented by Mr. W. Harrison, of the Siemens Laboratories, Preston, at the I.E.S. meeting in London on March 8. The paper surveyed the principles involved in the assessment of the colour-rendering quality of an illuminant. The relation between the spectral distribution of the light and its colour-rendering quality was discussed with particular reference to the spectral distribution differences which can be produced in white fluorescent lamps of the same colour. It was pointed out that owing to the subjective nature of colour appreciation, factors such as colour preferences and colour contrasts are of considerable importance in fluorescent lamp colour design.

Physical measurements are valuable for specification purposes, and it has been found that an adequate measure of the spectral distribution of an illuminant can be obtained by the eight-spectral band method of abridged spectro-photometry. The colour of the lamp itself can be accurately specified by its C.I.E. chromaticity co-ordinates and tolerances of any desired magnitude can readily be fixed.

The respective functions of spectral distribution and chromaticity co-ordinates data were indicated in some detail. It was also shown that for an adequate specification of the colour rendering quality the spectral distribution must be known. It is interesting to note, however, that chromaticity co-ordinates by themselves are sufficient to allow a useful comparison between lamps employing the same phosphor.

The paper included a summary of artificial daylight developments in this country which have been on the lines of special fluorescent lamps or the mixture of light from tungsten and fluorescent lamps.

The author said that there has perhaps been over-emphasis of the fact that the spectrum of the radiation from the fluorescent lamp generally shows some deficiency at the red end. An object of the present paper was to show that the requirement for successful colour performance is a well-balanced spectrum. An indication was given of the various lines of research directed towards this end.

LIGHTING IN COAL MINES

A series of short articles dealing with various aspects of an important lighting field

These articles are based on a series of short talks given at an I.E.S. informal meeting held in London on January 26 last.

This meeting resulted from a visit to the Chislet Colliery in Kent during the previous May, when I.E.S. members inspected one of the first fluorescent lighting installations in a coal mine in this country. The meeting was arranged so that those who took part could discuss their reactions, and the discussion was opened by the authors of the following articles. Mr. R. Crawford, chief electrical engineer to the National Coal Board, opened the meeting with a review of the problems which have to be faced by those responsible for lighting the mines.

Apart from the authors of these articles there were several other contributors to the discussion, including Dr. W. J. Wellwood Ferguson who showed a short film on Nystagmus.

At the conclusion of the meeting, Mr. Crawford, after commenting on the high standard of the discussion, said that he would be pleased to arrange for any I.E.S. member concerned with mine lighting to visit any convenient pit to gain first-hand knowledge of the problems.

The Problem

By R. CRAWFORD

Many of the difficulties encountered in the application of lighting underground are not fully appreciated by personnel outside the industry, and the interest now being shown by illuminating engineers is encouraging.

What is the problem? Firstly, perpetual darkness is a natural condition in a coal mine, and any lighting apparatus which is introduced must be safe in itself and add to the safety of the mine in general. To be able to work, the miner must have the light, and the better the light the better may he be expected to work. From the humanitarian point of view, good light produces more comfortable working conditions and thus further justifies the added cost. The provision of lighting, however, must not add to the risk of explosion or fire.

The mining of coal is a rough occupation and demands equipment of a standard of robustness not generally necessary in other industries. Mining machinery and equipment of all types has been developed over the years with this in mind, with the result that it will generally withstand abnormal usage without damage. Although it is appreciated that lighting fittings at the coal face should not be dropped or thrown about, the designer of such fittings would be well advised to accept such treatment as inevitable and plan his equipment accordingly. Half our maintenance troubles to-day with coal face lighting fittings are due to lack of appreciation of the treatment such fittings receive in normal mining conditions. For example, cable attachments fitted to both lighting fittings and to intermediate couplers should (in fact, must) provide security of attachments at least equal to the strength of the cable itself.

Underground lighting falls into three distinct categories, each requiring different treatment and different equipment. These are briefly :—

(a) Shaft bottom lighting—the nearest approach to surface lighting conditions and in various stages of development;

(b) Roadway lighting—in the past this has been applied somewhat haphazardly; and

(c) Coal face lighting—so far as really successful installations are concerned this is still in its infancy.

Fluorescent lighting has been introduced in a large number of pit bottoms with beneficial results. Apart from the increased illumination generally achieved, the colour of the fluorescent lamp when compared with the yellow light of the tungsten lamp is generally appreciated. The range of substantially constructed dust-tight and rustproof

Pit Bottom Lighting, Hilton Main Colliery.

(Photo by courtesy of the G.E.C.)

fittings is at the moment somewhat limited.

The second category, roadway lighting, cannot be disposed of in so few words since its application depends upon many important factors, some of which are undergoing radical changes at the moment.

Roadway Lighting

Underground roadways are provided for ventilation of the mine and for the transport of coal, men, and materials to and from the face and shafts. Rope haulage has for many years been the conventional system of transport underground. Its use has involved the provision of men often in quite considerable numbers at each each of the roads and at all intermediate junctions for the purpose of attaching and detaching tubs. The safety of such men necessitates the provision of lighting at all points where they work, but other parts of the road are generally in darkness. As stated in the Reid Report, and now generally accepted, the conventional rope haulage system will eventually give way, wherever conditions are suitable, to the use of locomotives. Such a change in practice obviously affects the problem of roadway lighting and the question arises as to whether continuous roadway lighting is necessary or justified.

The Germans have employed locomotive haulage for some considerable time and have, in some cases, adopted continuous roadway lighting, and justify its use on several grounds. The principal claim is that it facilitates better roadway and track maintenance, particularly where trolley locomotives are in use. As men, materials, and coal are all hauled by locomotives which have efficient headlights, there seems to be little other justification for lighting throughout a road of a three- or four-mile length.

Coal Face Lighting

Referring to the last of the three aspects, coal face lighting, we are confronted by a number of serious problems. Coal face lighting is obviously desirable from every point of view, provided it can be applied without introducing added risk of fire or explosion. It is clear to British mining engineers that its successful use in Continental coalfields is due to the absence of shot firing. In British mines about 74,000,000 shots per annum are fired on the coal face.

Safety considerations which we appreciate and must accept are seriously retarding the development of face lighting at present. The electrical inspectors of mines are rightly perturbed by the possibility of damage to fittings from flying fragments of coal after shot-firing. Such damage may expose incandescent

filaments or bring about short circuits which would be disastrous in the presence of fire damp.

Glass or "Perspex" as used at the present time have insufficient mechanical strength, and it is hoped that new developments in the plastic field will produce material of a greater impact resistance and of equal light transmission factors. It is surely not beyond the bounds of human endeavour to produce some suitable new material for this purpose as it was possible to build bullet-proof gun turret enclosures during the war without seriously obstructing the view.

The need for robust construction has already been referred to and could no doubt be easily achieved but for the parallel need of absolute minimum weight. The problem of combining lightness with strength is appreciated, but it is hoped that light metal alloys such as are already in use in coal mines, particularly for hand-held tools, may serve this purpose.

It is not proposed to discuss here the relative merits of fluorescent and tungsten lighting. Both have their place provided the glare problem can be dealt with effectively. At the same time, it must be pointed out that the "novelty aspect" of fluorescent lighting has been of considerable value in reviving interest in coal face illumination.

In conclusion, greater co-operation is required between the illuminating engineer and the user. There is no doubt that a considerable amount of money will be spent during the next few years in providing better light in coal mines, and it should be our common endeavour to see that the mine worker derives the maximum benefit from whatever money is expended.

Some Impressions of Modern Mine Lighting

By C. A. MORTON, B.Sc., A.M.I.E.E., F.I.E.S.

It is somewhat difficult for the layman to give a detailed survey of the lighting at Chislet Colliery after the lapse of time since the I.E.S. visit in April last year but the following impressions have been fairly well retained in the memory.

The immediate region of the lower end of the shaft was large and lofty with sides and roof well whitewashed and also well illuminated; principally with long fluorescent lamps. The height of the roof was reduced at the entrance to the haulage runway, and as the party progressed into the runway itself the surroundings became darker. The gradation of the general lighting background at the bottom of the shaft into that of the haulage runway itself was soon completed and the party moved into darkness where no lighting of any sort was installed. The only light that did exist was either from the lamps of

Coal Face Lighting, Hilton Main Colliery.

(Photo by courtesy of the G.E.C.)

approaching miners coming off shift or from the lamps carried by the party. Frequently one got the illusion of an apparently fixed light in the distance but it proved to be merely the light from a hand-lamp reflected back by the sheet aluminium of the coal trucks.

The party soon became dark adapted. It groped forward and could see in a general way largely because of the general spread of light resulting from the hand-lamps carried. For example it was possible to see and also to feel that the haulage track over which the party walked did not appear to have been laid with the precision that is associated with normal passenger traffic on the surface.

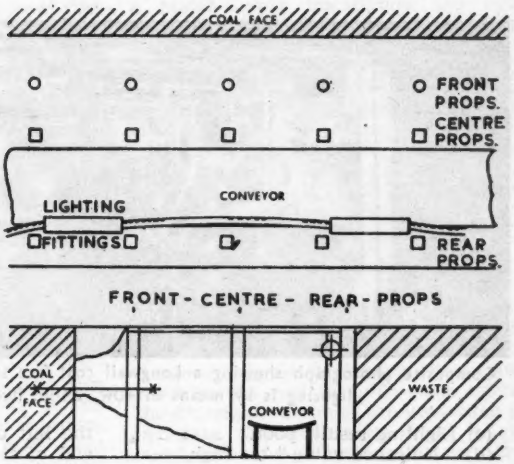
It was rather difficult to understand why such low, and, in fact, negligible illumination values should be considered sufficient for the haulage runway. The party moved towards the coal face at the change-over of the shifts, when the trucks were stationary. When the party returned, the trucks were moving; fortunately for the party, only in one direction. Perhaps it was too soon after the commencement of the afternoon shift, but there seemed to be no trucks being returned empty to the coal face on the other track. This undoubtedly added to the party's comfort. The trucks were wire drawn and were by no means in close spacing. Surely it is not expected that attention during haulage, particularly over the uneven tracks, never has to be given and therefore light is unnecessary?

The darkness of the haulage runway soon changed at the coal face itself into what is possibly best described in non-technical terms as a blaze of light; though it was far from glaring. The lighting was provided by 30-w. 18-inch daylight fluorescent lamps. The actual illumination value may not have been large but one could now really see in considerable detail and comfort—at least in optical comfort if not in physical comfort even at the four feet seam. Most outstanding was the colour discrimination possible—the light green pit props, the colours of the old Service uniforms that most of the party wore; and the pink skin of the bare backs of the miners coming to the shift. It gave one the impression that those collieries where the coal face is as well illuminated as at Chislet are fortunate indeed and that it was difficult to imagine how coal face work can be carried out efficiently in other collieries under illumination values comparable with those experienced in the runway at Chislet—in other words, by means of portable lamps alone.

It was mentioned above that one was not conscious of glare at the coal face; it is probable that most of the party, all lighting men, would agree with this. Indeed, it is probable that most lighting engineers, as a result of general experience in dealing with light sources, take glare in their stride. However, they are not the people who have to live with the light sources under these conditions. Unfortunately the viewpoint of the people who really matter, in other words, the men who endure the light sources all the shift is seldom, if ever, heard. Is there any information on this point? Do they have a new fitting thrust upon them, willy-nilly? The assessment of discomfort produced by glare is very much a personal matter, but even so, it is most important that the reactions of the men actively concerned should be given more emphasis than at present appears to be the case.

One begins to wonder whether the fluorescent lamp has been introduced into coal mining just because it was something new. We find at Chislet, and probably elsewhere, a light source of a brightness that when it is used in any surface industries receives considerable attention in regard to mounting height and cut-off angle. No such consideration is given to the minelighting fitting, despite the mounting height limitations. Admittedly the fitting has to be robust and universal in mounting and presumably the inevitable conclusion is that any protection from glare is perforce abandoned.

Although one might prefer fluorescent lamps in a mine to tungsten lamps on colour considerations and for general cheerfulness, it may be wondered whether, at the coal face, the fluorescent lamp and all that it implies is really worth while. The fluorescent lamp has, of course, a higher efficiency than a tungsten lamp of the same wattage but as the lamps become shorter this advantage begins to disappear. The length of the lamp, however, still controls the shape of the housing, which must also house all the necessary ballast and the starting devices, not to mention a



Layout of Coal Face: Longwall System.

special circuit to suit a 110-volt supply. The fitting in consequence is complicated and expensive. A simple tungsten unit has none of these complications. Such a fitting should not, however, consist of a glaring tungsten lamp behind a clear glass. The glass front should be covered completely with diffusing "Perspex," which will reduce the brightness of the luminous portion of the fitting to a magnitude that would be much more comfortable to direct vision.

The Portability of Coal Face Lighting Equipment

By G. E. CHAMBERS, B.Sc.

The most portable mines lighting equipment is the hand or cap lamp, but there is a limit to its usefulness. Weight considerations prevent either an increase in power or the provision of optical control to reduce glare. Therefore, although it seems likely that hand or cap lamps will be needed for some long time on a standby or safety basis at least, experiments in coal face lighting have been carried out in the past from three other aspects.

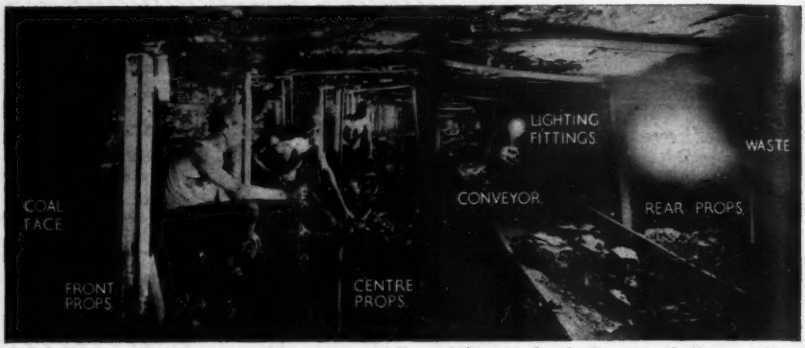
1. Accumulator lighting.
2. Pneumatic generator lighting.
3. Mains lighting.

1. *Accumulator Lighting.* — Experiments with 14-volt cells and lamps giving about 20 c.p. have been used to illuminate a whitewashed waste, giving excellent results. The scheme was found impracticable on any scale, however, on account of the difficulty of removing the batteries for charging, and of moving such heavy equipment about on the face. Thus the problem of portability was sufficiently awkward to make further experiment pointless.

2. *Pneumatic Generator Lighting.*— Where a compressed air supply is available on the coal face, as, for example, where pneumatic power drills are in use, combined generator and lamp units may be used. These may be considered, from the point of view of portability, with the mains-operated units below, since the problems involved are generally the same, except that these units may be left on the coal-face while shot firing is in progress, since they are intrinsically safe. The economies of such systems, however, are not as favourable as for a mains supply, and this consideration may outweigh the above advantage.

3. *Mains Lighting.*—The provision of mains-fed lighting on the coal face has so many desirable features that a number of trial installations, mostly incorporating tungsten lamps, have been carried out in the past, but they were mainly unsuccessful on one of the following counts:—

(a) Cost too high.
(b) Damage and wastage on equipment too heavy.



Composite photograph showing a Longwall coal face at Birch Coppice Colliery. The lighting is by means of 40w. 24-in. fluorescent lamps.

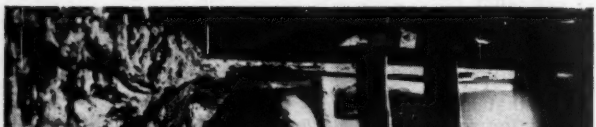
(c) Lighting results poor.
(d) "Nuisance value" too high.

This short article is concerned with the last of these factors, which is more nebulous than the others and more difficult of solution. It is perhaps not too optimistic to observe at this point that the present series of experiments on face lighting seem to indicate a happier approach to the first three points and that the right tools are now within our grasp and give good hope of success.

The "nuisance value" arises mainly from the temporary nature of any face installation since the coal face is, on the Longwall Advancing System, which is mostly used in British pits, moving forward into the seam daily. The difficulties are clearly seen from the photograph of a coal face in Birch Coppice Colliery, Staffordshire.

The coal is won from the "face" at the left of the photograph, and at the end of the "winning" shift a fourth row of pit props is installed, close to the new face. The conveyor is then dismantled and re-erected between the present front and central rows. The lighting fittings, which on this face incorporate 40-watt 24-in. fluorescent lamps, must be removed from their position on the rear props and replaced on the central props. The rear row is then removed and the roof allowed to collapse, the waste then being packed. The whole coal face area has thus moved forward into the seam by the distance of a few feet, and this routine is followed once every 24 hours.

The Birch Coppice seam is approximately 4 ft thick, but in many pits the height is 2 ft. or less, as, for example, in Cambois Pit, Northumberland, where a miner is seen handling equipment in a



Showing a coal face worker manipulating a cutter in a shallow seam at Cambois Pit, Northumberland. Lighting by 15w., 18-in. fluorescent lamps.

crouching position in the accompanying illustration. It will be appreciated that the awkwardness of man-handling even light equipment in such confined spaces is considerable, and will usually be subject to additional annoyance from dust, water or heat. The installation of lighting equipment represents extra work to be undertaken during the changeover, and this work may easily acquire a considerable nuisance value.

In addition to the regular removal of the lighting fittings as outlined above, it must be remembered that the overriding consideration underground must always be that of safety. This leads to regulations governing the maximum current which may be carried in a lighting circuit; laying down the provision of pilot and earth connections in all apparatus, so that if the circuit is broken no live metal can be exposed; setting out the requirement that all electrical apparatus in certain areas must be housed in a certified flameproof enclosure, and requiring that mains lighting fittings and cables must be removed from the face during shot-firing where that is carried out.

These regulations are, of course, wise and essential, and no one would desire their relaxation merely to simplify this or any other problem. They do, however, make the manipulation of lighting equipment even more difficult, and it will be seen that if this is not to be insuperable, very careful consideration of design and installation of mains-operated lighting fittings is required. The fitting designer is presented with conflicting specifications which call for a lightweight unit for ease of removal, and at the same time a robust and complicated unit to meet the flameproof requirement and to withstand the rough handling and misuse inevitable in such site conditions, even without the additional hazards of roof falls, flying coal, etc.

This analysis of the situation sets out only to state the problem, since much work is at present in hand, and much remains to be done. The solution will not come from the lighting engineer alone, but from his active co-operation with the electrical engineer, the mining engineer, and, most important, the coal face worker himself. The collier must decide whether the undoubted advantages which may now be obtained from a mains-supply installation are outweighed by the difficulties inherent in its application. If his final decision is favourable, the problem of portability will certainly have been met, for without its solution no system can work on other than an experimental basis.

Acknowledgments are made to the B.T.H. Co. for the illustrations used in this article and in the article on "Glare Under Mining Conditions."

Seeing Conditions in Mines

By W. J. VINE, F.I.E.S.

The problem of seeing in coal mines is somewhat simplified by the dark adaptation of the eyes of miners during the time they are descending the pit and reaching the coal face. To some extent the illumination values are graduated to facilitate this adaptation from bright sunshine at the pit head to the very low values obtained at the coal face. At the pit head the cages are inside shed-like structures with relatively little natural lighting and, during the descent, the only light in the cages is that from portable lamps. At the pit bottom, good general fluorescent lighting in conjunction with whitewashed walls and roof gives an illumination of about six foot-candles, which is ample for marshalling the coal tubs and loading them into the cages.

From this area, and going towards the coal face, one enters a region of incandescent lamp fittings of diminished output, and from there onwards for perhaps some two miles only hand or cap lamps provide the lighting necessary for movement along the road. During this period the eyes become accustomed to the lower levels of illumination. Here there is seldom any whitewashing except for dangerous projections from the roof or walls. Consequently, on arrival at the working face, owing to this process of adaptation the somewhat meagre illumination provided turns out to be sufficient for the job.

The Visual Task

The work at the coal face comprises:

(a) Movement of personnel in safety;
(b) Operation of coal cutting machinery;
(c) Hewing by pick and shovel;
(d) Manhandling the coal on to a mechanical conveyor.

One shift in three the conveyor has

to be dismantled, moved forward, and reconstructed; pit props have to be erected and electrical fittings and connections also have to be moved forward.

The brightness pattern is formed by the lighting fittings against a dark background void, with pit props standing out in relief and giving a degree of "perspective." The roof and ground levels are a medium grey against the black coal seam which is not uniformly black but which glitters, due to the light from the fittings being reflected off the small facets of the coal itself. This forms an ideal contrast on the vertical "working plane," and in conjunction with the dark adapted eye, provides quite reasonable seeing conditions. These conditions vary from pit to pit according to the type of coal, and with a dull matt coal higher lighting levels should be provided.

The illumination can, however, be augmented locally by cap or hand lamps, the former often being preferred since they project a beam of light along the normal line of vision.

Fluorescent lamps give better contrasts than do tungsten lamps. This is due to the whiter light emitted, compared with the yellow-red light of a tungsten filament lamp.

Owing to the relatively wide spacing of fittings, coupled with the presence of a number of vertical obstructions in the form of pit props and miners' bodies, some degree of shadow does arise. This, however, is largely mitigated by the use of cap lamps.

Glare Under Mining Conditions

By G. E. CHAMBERS, B.Sc.

The Regulations of the Factory Act governing glare in industrial premises lay down that no part of an artificial light source at less than 16 ft. mounting height must be visible if the brightness exceeds 10 candles per sq. in., except where the angle of elevation exceeds 20 deg. The corresponding ordinance contained in the Coal Mines (Lighting) General Regulations, 1947, now governing underground lighting, requires that "so far as reasonably practicable, the lighting provided shall be so arranged as to prevent glare."

This second Regulation is, in the widest sense, general, and this may be attributed to the vast disparity between lighting standards and conditions underground and those obtaining in the normal factory. The volume of work to be done in the mining field, from the lighting viewpoint, is so formidable that it may be thought dangerous to be too specific at this stage lest enthusiasm be curbed and progress thereby inhibited.

It is, however, precisely because current lighting standards are low in mines that the necessity for the strictest possible control of glare becomes of paramount importance. All illumination is necessarily artificial and the eye is dark-adapted to low brightness levels. Thus it does not require much light flux to enter the eye in order to cause disability.

Even if artificial illumination underground were at the same standard as on the surface, the lighting engineer would still be faced with two further glare problems intrinsic in the mechanics of the coal mine.

Firstly, all mounting heights are low. In the roadway, average heights vary from 8 ft. down to 4 ft., and at the coal face, from 4 ft. down to 1 ft. 6 in. in some cases. Thus several sources will normally be in the direct field of view at any one time and, because the provision of cut-off becomes inefficient at such mounting heights, these may easily become sources of glare.

Secondly, background reflectivities are low, and will not generally exceed 8 per cent. to 10 per cent, unless steps are taken artificially to increase them. Thus, glare due to excessive brightness contrast between source and background is difficult to avoid.

As illustrations of the ease with which glare can arise it is perhaps relevant to quote two examples familiar to all who have travelled underground in mines. A miner must carry a hand or cap lamp with him at all times after leaving the surface, and these generally have a "dim" or "standby" switch position. When a shift of colliers is moving along an unlit roadway towards the coal face, even if their lamps are dim, a person moving towards them along the roadway finds it difficult to avoid a combination of discomfort and disability glare which makes an annoying measure of re-adaptation necessary.

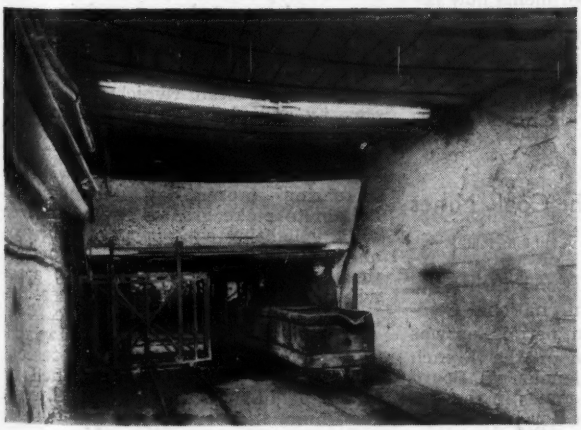
The same trouble is experienced by the coal face worker, who normally uses a cap lamp, which has a higher beam candle-power than the hand lamp, and has the additional advantage of

Showing good roadway lighting at Merry Lees Colliery. 20-w. fluorescent units spaced at 45 ft.

leaving both hands free. Part of his task is to shovel coal from the face in front of him to a conveyor which runs behind him. In turning, he is likely to direct his lamp beam into the eyes of his mate at the next stint, some few yards distant only.

It has been seen that glare may easily be caused underground, either due to an excess of light flux entering the dark-adapted eye, or to too great a contrast between source and background brightnesses, or to a combination of both. Let us outline methods by which glare may be reduced to within reasonable limits.

One method is to reduce the brightness contrast by increasing thte reflection tractor, and therefore the brightness, of the background. It is, in fact, now mandatory to whiten, and keep white, the roof and walls at all places in the mine where permanent lighting must be installed. In many pits, stonedusting is carried out to prevent coal dust explosions, and, the material used happily being of fairly high reflectivity, the same process is used for both purposes. This requirement, which is set out in the Coal Mines (Lighting) General Regulations, 1947, is an excellent legislation, and the moral it points could, in many instances, be considered in sur-



Pit bottom installation at Chislet Colliery using 80-w. fluorescent lamps in dustproof fittings.

face industrial lighting practice with some advantage.

A relatively large-area source, such as the fluorescent lamp, has an intrinsic advantage over the more compact sources in that, for equal light output, the brightness is considerably lower, and therefore the use of such sources, other considerations being equal, is strongly to be urged. Where sources of small area are used an urgent need arises for strict optical control, by prismatic systems, or by the provision of adequate diffusion. The introduction of higher efficiency diffusers, such as are at present becoming available, may make this task easier, since inefficient diffusers or prism systems lead to losses and unnecessary energy consumption, which is a double embarrassment underground where cabling, switchgear, and transformers are costly and strictly rationed.

By suitable siting of fittings, particularly in roadways, much can be done to remove bright sources from the field of vision altogether, and several good installations based on this principle have been carried out, mostly employing small alcoves high in the roadway walls.

On the coal face space is so limited and the problems arising from the impermanency of the installation so acute that the strongest approach would seem to be to attack the trouble at source, that is, at the lamp. This is borne out by the fact that the introduction of the fluorescent lamp, particularly in its shorter forms, has given recent impetus to the study of the lighting problem at the coal face. The experiments now being carried out under the aegis of the National Coal Board will give us added experience in this and many other problems which make underground lighting the most interesting and at the same time the most worthwhile of the many aspects of lighting.

Lighting in French Coal Mines

By H. S. ALLPRESS, A.M.I.E.E., F.I.E.S.

Arising out of discussions during the Paris meeting of the International Commission on Illumination, permission was given by the director of the French equivalent to our National Coal Board for the author to visit mines in the Pas de Calais region to see for himself the test installations which had been referred to in the report presented to the Conference.

The general scheme of underground electrification proposed for the French pits includes the provision of a relatively high proportion of flameproof gear together with the inclusion of mains-fed portable lamps connected by flexible cable—an arrangement which is not permitted under British regulations. As in England, there is a single authority for the certification of flameproof fittings and the regulations covering electrical apparatus show a number of minor differences in temperatures and general practice, of which, perhaps, the most important, from the point of view of the English designer, is that the use of toughened glass is not essential. Annealed glass is generally used as "Perspex" is expensive on the Continent and not so readily available.

There appears to be little cap lighting at present in the French coalfields, although there are proposals under consideration for a great extension of this form of lighting. Battery hand lamps are at present in general use, and the author was pleased to note at least one well-known English maufacturer's products being tried out.

At the Sabatier Colliery little flameproof lighting was actually observed. Sections of roadway lighted from the mains were well out-bye in the vicinity of pit bottom. Here fittings of the watertight well-glass "protective" pattern were in use. Some "bare" lamps were noted, however. These were inside wire cages and mounted on porcelain lampholders, which also supported the V.R.I. or P.B.J. type cable—the arrangement being not unlike similar lighting on the Paris Metropolitan (which is noted at once by any visitor interested in such matters).

This use of non-flameproof lighting below ground is in conformity with the increasing present-day tendency in Britain to make greater use of modern colliery lighting equipment of this type and to limit, in the interests of economy, the use of "F.L.P." apparatus to areas where "Special Regulations," necessitating the certified type, are in force.

At pit bottom, in France as in England, trials have been made of fluorescent lighting, and the figures published by M. Huguenin show that in general terms the illumination can be increased three

times for the same energy consumption by replacing (on an equal wattage basis) filament lamps and fittings by fluorescent tubes of 1 metre length (22.5 watts) in standard sheet steel industrial-type troughs.

Satisfactory roadway lighting installations using filament lamps in well-glass fittings confirm that it is quite possible to obtain satisfactory roadway lighting with filament lamps, and the decision as to whether or not to install fluorescent lighting in these areas must be primarily based upon economic considerations in respect of the saving in energy consumption as against increased capital expenditure in the first instance.

It is exactly this problem that the French Technical Service, attached to the French collieries, is investigating at the moment, and it is understood that it is to be decided whether energy is to be saved by providing approximately equivalent illumination, or advantage taken of the efficiency of fluorescent lamps to improve the intensity and evenness of illumination. It is probable that the final solution will be a balance between these two main factors.

The results of the experiments so far, as published in a paper presented by M. Huguenin at the International Conference, are that the illumination at pit bottom should be of the order of 8 foot-candles at a height of 4 ft. above the floor, and that a ratio of $\frac{E_{max}}{E_{min}}$ should be maintained at about 5.

It is believed that in France the proposals of the mining authorities, who are anxious to alleviate the lot of the miner as far as technical developments and finance will permit, are that they should proceed with the progressive introduction of cap lamps in place of portable hand lamps and concentrate on the installation of improved general lighting by means of fluorescent lamps in roadways, at pit bottom and haulage points where workers are concentrated or where the traffic is especially heavy.

At the same time, important as may be the lighting of haulage roadways, it is felt in France, again as in England, that the best return both in output and improved amenity value to the miners will be obtained by providing general lighting at the coal face.

For the French experiments 24-in. lamps in tubular-type flameproof fittings, without reflectors, are operated *vertically* in front of the conveyor, which is nearer to the coal face than is usual in English practice.

It is claimed that this system of lighting layout, using vertical lamps, increases uniformity of illumination between adjacent units, and it can certainly be proved mathematically that this must be so according to calculations from the polar curve of the fittings. It is claimed that the fact that the lamp is parallel to pit props does not, in practice, give rise to annoying shadows.

Shot firing is not, however, usual in France as it is in England, and it is therefore difficult to see how this system can be applied to the standard English layout for long-wall mining.

Tests in the electrical laboratory at the Valenciennes group of mines show that with the 24-in. tube mounted vertically the ratio of $\frac{E_{max}}{E_{min}}$ will be 6.8, whereas with the lamps horizontal this ratio will increase to 88 under the same spacing conditions (i.e., with the lamps 20 in. from the coal face and E_{min} measured at a distance of 80 in. from the axis of the lamp.

The vertical, as against the horizontal, lamp appears to be the main difference between French and English practice in coal face lighting at present.

A Lighting Slide Rule

Those who have laboured with trigonometrical tables in calculating the illumination distribution given by a floodlight or a street lighting installation will welcome a new calculator which has been introduced by Messrs. Holophane, Ltd. This is built in the form of a 10-inch slide rule with scales for height or distance, intensity (candle power), illumination, and the angles in plan and in elevation, together with scales for the effect of depreciation.

A description of the methods of using the calculator and of its application to a variety of illumination problems is given in an instruction book which accompanies the calculator. This deals with all the commoner problems of calculating direct illumination in simple language.

The calculator, with the instruction book and case, is sold at £3 3s. by Messrs. Holophane, Ltd., Elverton-street, Vincent-square, London, S.W.1.

Factory Lighting

Annual Report of the Chief Inspector of Factories 1947*

The Annual Report for the year 1947, by Mr. G. P. Barnett, H.M. Chief Inspector of Factories, contains an interesting section on lighting. During the period under review factories were still in the process of recovering from war-time conditions, whilst the fuel crisis during the year had, as the report says, "unusually marked effects on industry."

The section of the report dealing with lighting is quoted below:—

In some areas it is reported that the last traces of wartime black-out have now disappeared but in others its removal is still not yet complete. Although shortage of glass has delayed a return to pre-war conditions of natural lighting in these latter cases, use has been made of what glass has been available, or resort had to the use of translucent plastic material, to obtain some daylight and ensure that continuous working in artificial lighting is avoided. One firm occupying a factory constructed during the war without any windows or roof lights has been endeavouring for a considerable time without success to obtain a licence to install glass in 10% of the roof at a cost of £18,000. As a contrast to this a case is recorded of a long workroom of 180,000 square feet superficial area where the maximum amount of daylight is obtained. The four sides, except for a few feet from the floor, and the whole roof are entirely of glass.

The important effect of adequate natural lighting in diminishing the demand on electric supply is obvious: in the case of one large workroom in a factory the management were able to show a saving of lighting load of approximately 100 KVA. since restoring all their roof glazing.

New or reconverted factories usually incorporate reasonable day-lighting, and Inspectors have made full use of the co-operation arrangements with Local Authorities for ensuring that suitable provision is made in new factories at the planning stage. Additional glazing has been suggested in a number of cases. A large factory erected during the year incorporated points of special interest in respect of lighting, both natural and artificial. The very large glass area in the North light roof type of construction is equal to over 40% of the floor area. The use of precast concrete beams which permit of large unobstructed spans, together with light natural tone roof lining and a granolithic floor of very high reflection factor, enables an astonishing degree of day-lighting to be obtained, equal to studio lighting. The absence of obstructions like stanchions, trusses, etc., gave a very clean appearance to the factory. The firm found, too, that their consumption of current for lighting was only a quarter of that in their London factory with infinitely better results.

New factories are generally designed with good artificial lighting systems. Frequently it is found that fluorescent lighting as a complete installation throughout is specified. Managements appear to favour its use on account of its flexibility and the ease with which it can be moved. Many firms, except where heavy machinery is involved, are frequently altering their production lines and a rigidly fixed lighting system becomes a disadvantage in such circumstances. Flexibility of lighting is therefore an important attribute at the present time in the design of many factories engaged in the lighter industries. An interesting series of experiments was carried out at a large clothing factory working on planned production lines in the siting of fluorescent units so as to give the best results of high intensity of lighting at the bench, and particularly at the sewing machine needles. It was found that, contrary to the normal method of installation, the most satisfactory illumination was obtained with the fluorescent lamps placed at right angles to the length of the benches instead of along the line of the bench or at an angle of 45°.

Good results have been reported where fluorescent lighting has been installed in low pitched rooms, e.g., old mill-like buildings, small concrete structures and semi-basement rooms. The close approximation to daylight, particularly where the natural lighting is not good, is reported as having a beneficial effect on workers. In the case of a large laundry using this system of lighting with an intensity of 20 foot-candles at working level the management were enthusiastic in their praises, alleging that output improved in quality and quantity and that there was improved morale and reduced sickness absence amongst the workers.

Smaller factories appear to favour fluorescent lighting for an additional reason—the fact that it is not difficult to install. One Inspector reports the case of a small works where, although it was proposed to move to other premises

* H.M. Stationery Office. Price 2s. 6d. net.

within a year or so, the firm was quite prepared to install fluorescent units in spite of the cost, as they could readily be taken down and refitted at the new works.

The electricity load-spreading which has had to be resorted to at certain periods had varying effects on lighting in factories, some good, some bad. Some Inspectors point out that in a number of works managements decided to overhaul the lighting system, eliminating ill-planned and extravagant systems and replacing them with well-conceived installations arranged on scientific lines; on the other hand, there was undoubtedly a tendency in those cases where schemes of combined general and local lighting were installed for current to be saved by using only local lights whereby the illumination of the works as a whole was uneven and unsatisfactory. Yet others installed generating plant of various types either of sufficient capacity to provide current for both power and lighting loads or merely to provide current for the latter. One interesting case is quoted where not only did the plant installed generate current for all purposes, but exhaust steam from the turbine was passed through an intercharger so as to supply heating for the factory as well, utilising unrationed fuel-coke breeze.

Much improvement in artificial lighting remains to be done in certain industries, e.g., gas works, paper mills, cement works, and although progress is reported in letterpress printing factories in the London area, typesetting not infrequently has been found being carried out with an intensity of only 2 or 3 foot-candles.

Interference with lamp reflectors and bulbs is still very common, with the result that direct glare is probably the most marked defect in lighting. Workers, for example, remove reflectors on local lighting or replace the bulbs of such lamps with some of higher wattage which often project beyond the reflector designed for a smaller lamp. Low voltage lighting systems do not lend themselves to such interference, nor does, of course, the fluorescent unit.

One aspect of artificial lighting which has not received the attention it deserves is the illumination of yards, roads and precincts of large factories. Too often where there is artificial lighting it has been done piecemeal by the electrician for some particular purpose, and rarely is it scientifically planned to give adequate intensity over the whole area, minimum of glare and avoidance of awkward shadows.

I.E.S. Meetings

LONDON

April 12th

Sessional Meeting. Mr. J. G. Holmes on "The Manufacture of Lighting Glass," and Mr. P. Hartill on "The Manufacture of Metal Parts for Lighting Fittings." (At the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.) 6 p.m.

(NOTE.—*The Informal Meeting provisionally arranged for April 27th has been cancelled.*)

May 10th

Annual General Meeting, followed by an Address by Monsieur L. Gaymard in the Lecture Theatre of the Royal Society of Arts, John Adam Street, London, W.C.2. 6 p.m.

CENTRES AND GROUPS

April 1st

Presidential Address by Mr. J. M. Waldram, and Annual Dinner. (At the Grand Hotel, Bristol.)

April 5th

Dr. A. J. Holland on "Glass in the Service of Light." (At the Lecture Theatre of the British Electricity Authority's Showroom, Whitechapel, Liverpool, 1.) 6 p.m.

April 6th

Annual General Meeting. Mr. R. P. Wingate on "The Maintenance of Lighting Equipment and Installations." (At the Minor Durant Hall, Oxford Street, Newcastle-on-Tyne.) 6.15 p.m.

April 7th

Mr. C. Dykes-Brown on "High Voltage Lighting." (At the South Wales Institute of Engineers, Park Place, Cardiff.) 5.45 p.m.

April 8th

Mr. T. S. Jones on "Lighting in the Textile Industry." (At the Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

April 8th

Mr. K. T. Waters on "Seeing Conditions in Relation to Industrial Health." (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

April 11th

Annual General Meeting and Presidential Address by Mr. J. M. Waldram. (At the No. 4 Sub Area Offices, Yorkshire Electricity Board, Whitehall Road, Leeds 1.) 6 p.m.

April 14th

Dr. J. W. T. Strange on "New Developments in Fluorescent Lighting." (Joint Meeting with the Institution of Electronics.) (At the Reynolds Hall, Manchester College of Technology, Sackville Street, Manchester.) 6 p.m.

April 14th

Mr. E. Stroud on "Light Control" (At the Lecture Hall, Brighton Technical College, Brighton.) 7.30 p.m.

April 25th

Annual General Meeting and Presidential Address by Mr. J. M. Waldram. (At the Medical Library, The University, Western Bank, Sheffield.) 6 p.m.

April 28th

Film Evening. (At the Demonstration Theatre, of the East Midland Electricity Board, Charles Street, Leicester.) 6.30 p.m.

April 29th

Birmingham Centre Visit to an Industrial Plant.

April 29th

Film Evening and Annual General Meeting. (At the Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

New Lighting Installations

Lighting in a Mending Room

The illustration on this page shows one of the mending rooms of Messrs. Scott (Dudley Hill), Ltd., at Hemsworth, South Yorkshire, and illustrates the mending tables. Mending is an intermediate process between weaving and dyeing and finishing whereby faults in the woven cloth are corrected.

One girl normally sits at each table and starts off with a piece of cloth behind the table. This is gradually pulled over to the front whilst she inspects the piece for faults, and mending consists of pulling out faulty, thick or incorrectly woven threads and, where necessary, using a needle to sew in a length of yarn to reconstitute the pattern.

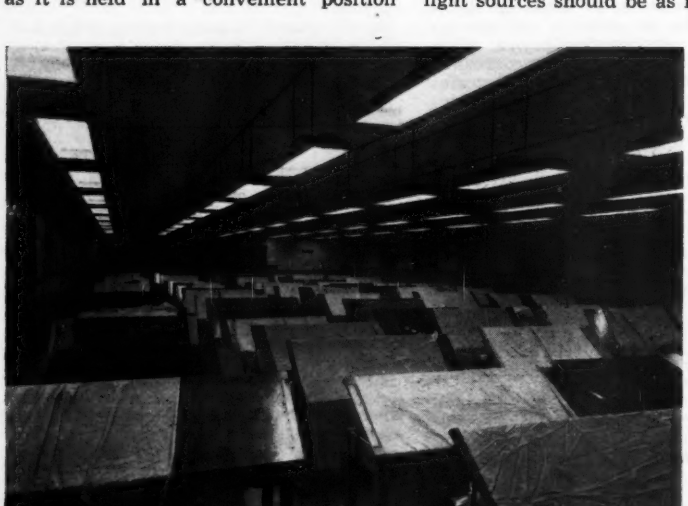
There are, therefore, two main visual tasks of which the second is probably the more arduous. Firstly, inspecting the cloth. Secondly, mending the cloth as it is held in a convenient position over the kness, i.e., at the bottom edge of the table.

Good lighting is essential, and the mending room illustrated, consisting of 100 mending tables, is illuminated with 50 Benjamin Type "A" Twin 5 ft. Fluroliers, installed by the electrical contractors, Messrs. Lees and Birch, of Hemsworth.

Old Brompton-road Sub-Station

A lighting installation recently completed in the control room of the London Electricity Board's new sub-station in Old Brompton-road, London, is an admirable example of the effect obtainable by co-operative planning between architect and lighting engineer. The installation was designed by the British Thomson-Houston Company in conjunction with the architects, Messrs. Stanley Peach and Partners.

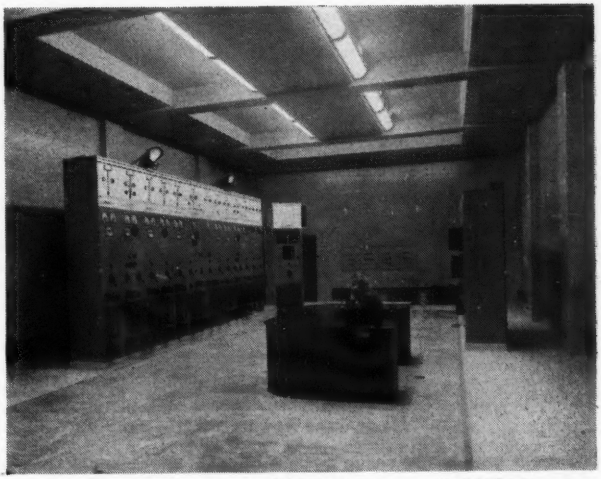
Special fluorescent fittings were designed for mounting in the angles of coffers in the false ceiling, so that the light sources should be as inconspicuous



A view of the mending room where faults in woven cloth are corrected.

as possible. Each consists of a semi-circular "Perspex" diffusing cover behind which is situated a metal reflector and two 80 watt daylight fluorescent lamps. Also incorporated in each fitting is a 60 watt tungsten filament lamp for emergency D.C. operation.

The main light distribution is at approximately 30 degrees to the downward vertical permitting excellent illumination of the control panels. A general intensity of illumination of 25-30 lumens per sq. ft. is obtained; at the bottom of the control panels, in a vertical plane, the intensity is 15 lumens per sq. ft.



Showing the lighting at Old Brompton-road Sub-Station.

Particular consideration was given to the colour of the decorations, which, by reason of peach-tiled walls, a light "Terrazo" floor and a pale ceiling, blends excellently with the fluorescent lighting.

Messrs. Troughton and Young, under the direction of the architects, were responsible for the actual electrical installation, and the false ceiling was constructed by the Trussed Concrete Steel Company. This ceiling is fabricated in "Hyrib," composed of an expanded metal base on which a plaster ceiling is built.

Lighting in a Silk Factory

The suitability of fluorescent lighting in the textile industry is clearly evidenced by the large number of installations of this nature at present being handled by contractors. Even lighting without glare to avoid eyestrain to operators working at the intricate machinery is one of the main considerations, and in a recent installation undertaken at the Perivale Mills of Messrs. Sewing Silks Limited this has been effectively achieved. The electrical contractors, Messrs. H. Buckle, of Ealing, using Ekco-Ensign fluorescent fittings have obtained a satisfactory and efficient lighting effect without variation down the long rows of spinning frames.

The fittings chosen for the installation used 5-ft. 80-watt tubes and were installed in groups of four between the frames and conduit suspended 8-ft. above floor level. The grouping of the fittings is an aid to easy installation and servicing so essential in modern factory conditions.

Maidenhead Town Hall

Pleasant, glare-free illumination in the auditorium is essential to the comfort and appreciation of audiences in a large hall, particularly where various forms of entertainment are likely to take place. A lighting scheme to meet these requirements has recently been installed in Maidenhead Town Hall as part of a redecoration plan. The installation was designed jointly by the Borough Surveyor and the British Thomson-Houston Company; the electrical work was carried out by the Southern Electricity Board.

The main lighting is derived from a small cornice at the spring of the ceiling arch (20 ft. above floor level) which has been extended to form a continuous translucent cornice along each side wall. The fittings consist of fluted, flashed opal "Perspex" screens supported by brackets mounted at intervals varying from 3 ft. 1½ in. to 5 ft. Control gear

Maidenhead Town Hall.

channels, which also serve as continuous wiring channels, are positioned behind the lamps. As an additional decorative feature, eight indirect, sconce wall fittings are mounted just above eye level. These take the form of a 40-watt fluorescent lamp threaded through spinnings of trumpet shape, mounted to a decorative backplate. These wall fittings are finished in a coloured cellulose spray and provide a delightful play of light and shade in contrast to the good general lighting from the cornice lines.

The creation of a congenial atmosphere is greatly assisted by the fact that the proportions and architectural beauty of the ceiling are made fully apparent by this lighting.

Lighting in a Snack Bar

An interesting example of the use of "Peach" fluorescent tubes is provided in the basement snack bar of Simpson's, of Piccadilly. The tubes are concealed in a rectangular cornice which has glazed appertures on the underside so that the tubes give indirect lighting whilst at the same time providing direct lighting for the counter immediately below.

The favourable appearance of food and drink has been commented upon. The tubes and gear were manufactured by Thorn Electrical Industries.

A view of Simpson's Snack Bar, Piccadilly.

I.E.S. ACTIVITIES

Visit to the London Palladium

On the morning of February 22 some 40 I.E.S. members, including some Centre members, took part in a visit to the London Palladium to see the stage lighting. The visit, which was by courtesy of Mr. Val Parnell, managing director of Moss' Empires, was arranged by Mr. L. G. Applebee. The party was received by Mr. Charles Henry, head of the Theatre Production Department of Moss' Empires, and Mr. Barry Storey, the manager of the theatre.

With the party seated in the front of the Grand Circle a demonstration was given of the "Console" method of stage lighting control, which has been in use at this theatre for some years. The inventor of this system, Mr. Frederick Bentham, who is a member of the I.E.S., described the operation of the "Console" and the advantages of this method of control.

During the demonstration foot-candle readings were taken on the stage, though it was pointed out that this was a very rare occurrence in the theatre, illumination values as such being of no real interest to producers. This was done, however, merely to give the visitors some indication of the amount of light directed on to the stage. (The actual readings varied according to the type of lighting used, from 100 to over 500 lm. sq. ft.).

After seeing the stage lighting from the front of the house the party then went on to the stage, where they saw the lighting from the artistes' point of view. The various stage equipment was demonstrated, and the party went below the stage to see the remote control gear for the "Console" system. Some of the visitors also inspected the lighting in the dressing-rooms.

At the conclusion of the visit Mr. J. M. Waldram, president of the I.E.S., thanked Mr. Charles Henry and the staff of the theatre for the trouble they had taken.

Sheffield Centre

At the sessional meeting, held on February 7, 1949, at the University, Sheffield, Mr. D. C. James gave a very interesting lecture on store and display lighting. The lecturer carried out a lucid survey of light sources at present available, dealing mainly with the advantages and disadvantages according to the particular lighting application which might be under consideration. Demonstrations were given of the light sources mentioned, together with a display of their colour-matching properties. The colour distortion obtained by the use of fluorescent lamps was also demonstrated.

Nottingham Centre

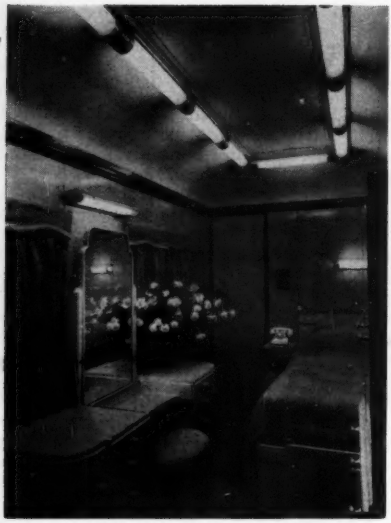
The technique and future possibilities of fluorescent lighting in transport vehicles were reviewed in a paper read on January 7 at a meeting of the Nottingham Centre by Mr. C. Dykes Brown and Mr. S. Anderson.

It was pointed out that because of limitations of space, lamps in vehicles had to be fairly close to the passengers' normal direction of vision, so that unshaded filament lamps tended to be too bright for comfort. At the same time a higher illumination than the present average of 4 or 5 lumens per sq. ft. on the reading plane was desirable. Better distribution of light and softer shadows were other needed improvements in vehicle lighting, and it would be easier to achieve all these with fluorescent than with tungsten filament lamps.

Most vehicle fluorescent installations in this country made use of the hot cathode 1½-ft. 15-watt or 2-ft. 20-watt lamps, which could be accommodated in compact fittings, and permitted greater flexibility of layout than would be possible with longer lamps. Lamps of these dimensions could be operated from a supply of about 100 volts.

Cold cathode fluorescent tubes had special attractions for train lighting. With this type of lamp is was possible to compensate for the deficiency of deep red rays by using tubes with a neon filling in combination with one of the white colours. "Warm White" and "Gold" tubes together gave a light of attractive quality, quite suitable for coaches in which food was served, such as restaurant and buffet cars.

The life of cold cathode tubes run at



Fluorescent lighting on the train used for the Royal Tour of South Africa.
Left—**The Queen's bedroom.** *Right*—**The King's bedroom.**
(Photos by courtesy of the G.E.C., Ltd.).

60 mA. exceeded 10,000 hr. and might attain 15,000 hr. Replacement of tubes and attention to gear therefore might well coincide with the periodical visits of the rolling stock to shops for major overhaul. Ordinary cleaning of the tubes could be safeguarded by providing the fittings with interlocks to break the circuit when opened for access to tubes and gear.

There were some railway vehicles in which a 110-volt D.C. electrical supply was provided, primarily for air-conditioning and similar amenities. Hot cathode lamps in the 1½-ft. and 2-ft. sizes could then be operated direct from the batteries, suitable precautions being taken to stabilise the lamp current and prevent incorrect operation of starter switches in varying conditions of battery voltage. The paper described a relay and circuit for preventing low voltage from causing the contacts of thermal starters to close while the lamps were alight. In any D.C. fluorescent installation it was necessary to reverse the polarity at intervals to prevent a "darkening" effect at one end of the lamps. It was found that reversal once every 24 hours was sufficient practically to eliminate this effect when short lamps were used. The efficiency of a 110-volt D.C. system using ballast resistances (preferably tungsten lamps) compared favourably with that of a 24-volt installation with rotary convertor and chokes. An interesting example of railway fluorescent lighting at 110-volts D.C. had been in the Royal Train for South Africa.

Modifications were required to existing vehicles in order to equip them with fluorescent lighting, but it was probable that as new stock was built this type of illumination would be increasingly adopted, since the designs could be prepared from the outset so as to use it to the best advantage.

Newcastle Centre

On February 2 the Newcastle Centre had a visit from Mr. C. R. Bicknell, who gave his paper "The Application of Modern Flash Discharge Tubes." In addition to a good representation of the Centre's members they also had many visitors, some of whom were members of the local Photographic Society.

The paper concerned has already been reviewed in the "Transactions."

Mr. H. L. James, the chairman of the Centre, in declaring the meeting open

for discussion complimented Mr. Bicknell on the methods used in connection with his talk and endorsed the warning which Mr. Bicknell had given of dealing with charged condensers.

Mr. Pegg—a local photographer of repute—opened the discussion and referred to the spectral nature of the emission of the electric discharge lamp. From his experience he had found that the film needed a longer developing time, something like twice as long as that taken with normal flash bulbs. He also suggested that in regard to colour reaction the flash discharge tube was deficient in red and wondered whether more could be introduced into the spectrum as the result at the moment was not equal to daylight or normal flash-bulb results.

He also asked why it was necessary to make the modelling lamp of low voltage instead of the normal line voltage.

Mr. J. S. McCulloch asked what was the energy quantity when the lamp was under continuous use. He also asked if it was possible to use this form of illuminant for the examination of steel creep in connection with gas turbines running up to say 12,000 r.p.m.

Mr. Prince referring to the colour rendering of the flash discharge bulb suggested that the band width more approaching daylight might be obtained using carbon dioxide in the lamp in preference to Xenon.

Replying to Mr. Pegg on colour reaction, Mr. Bicknell pointed out that the flash discharge tube light output had a good actinic value and that after several experiments it was found that the best balance was experienced with Xenon gas.

Regarding the length of time required for developing Mr. Bicknell suggested that this may be due to the emulsion on the film or plate being too slow for flash photography; this is based on the assumption that the light output of the flash equipment used was adequate.

In connection with the voltage of the modelling lamp, this was decided on to obviate the danger of the high voltage getting on to the main should there be a breakdown in the electrical system. The transformer completely isolates the modelling lamp circuit from the mains.

Referring to Mr. McCulloch's query regarding the energy quantity output, he suggested that if a quartz envelope was used it would be up to five times better than the hard glass envelope normally used, this latter purely being used as it was of economic advantage. Dealing with the query on the examination of steel creep on gas turbines it was possible to flash the lamp up to 1,000 times per second but for this purpose it was necessary to install a capacitron circuit in the tube.

In a communicated reply to the query by Mr. Prince, Mr. Bicknell said that when using carbon dioxide one flash of light only would be experienced after which the gas would break down.

Leeds Centre

At the fifth sessional meeting of the Leeds Centre, on February 14, Dr. J. H. Nelson presented his paper entitled "Industry and Colour," Dr. Nelson's lecture following the lines of his published paper ("Transactions," Vol. XII, No. 9, 1947). A most stimulating discussion followed the lecture.

Mr. H. Edmondson said that a typical example of every-day bad brightness toning was the ordinary sewing machine and asked if any attempts had been made to improve the decoration of these machines.

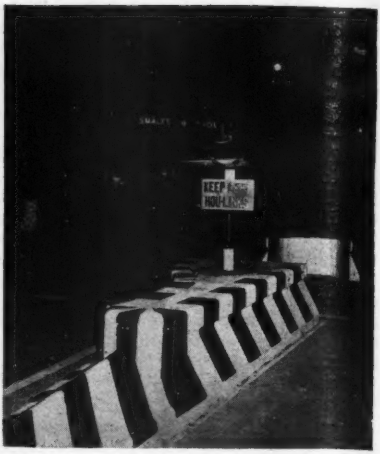
Mr. J. R. Bardsley said that one of the major benefits expected from decoration schemes in factories was an increase in production and a decrease in accident rate, and asked if there were any statistics available on these points. Mr. A. Wilcock, taking up this point, mentioned the case of a certain engineering firm which had carried out a decoration scheme where, though there were no actual figures available, it was understood that the resulting increase in production and the reduction in accident rate were considerable.

Many other points were raised by different speakers including the suggestion that attention must be given to actual seeing tasks involved when planning decoration schemes.

In replying to the discussion Dr. Nelson said that the few experiments which had been carried out on sewing machines had been quite successful. He said that no statistics regarding production and accident rates were available, as to have any value such figures must be very carefully compiled over a long period.

Street Lighting

The photograph alongside shows one of a number of traffic islands erected in East London, South Africa, illuminated by a 1,000-watt Benjamin "Duoflux" unit. Previously, although the streets are very wide, there were no traffic islands, and it is understood that the standard of driving in this town is very bad. It was decided to erect islands, and even before the job was finished three motorists wrecked their cars on these obstructions. The local authorities, therefore, decided to illuminate the islands in a manner which could leave no possible doubt as to their presence. As the sign is only 18 in. from the 1,000-watt lamp it stands out as a beacon which can be seen quite clearly.

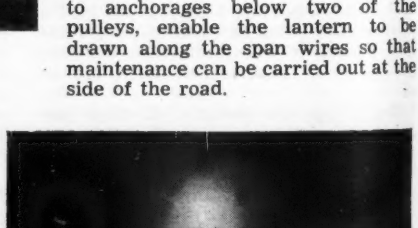


Wilmslow, near Manchester, has been equipped recently with sodium street lighting covering about 2½ miles of road. For this installation the G.E.C. supplied 93 lanterns with 140-watt sodium lamps. Special attention was paid to the siting of the columns so that they should not be too obtrusive in a setting of which the natural beauty has earned for Wilmslow the name of "the largest village in England." The light distribution of the lantern with its horizontally burning lamp is particularly helpful on broad roads. The average spacing of the columns is about 140 ft., giving approximately 4,400 lumens per 100 ft. of carriageway.

The first fluorescent street lighting installations in Denmark has recently been put into commission in the main street of the port of Esbjerg.

In all, 34 lanterns, supplied by the export department of the B.T.H. Co. are now in operation. In the main street, Kongensgade (left), there are 28 lanterns mounted on catenary wires spaced 25 to 30 metres apart.

The particular type of street lighting lantern used in the Esbjerg installation, is specially designed for catenary mounting. Four pulleys are bolted, one to each corner of the lantern chassis, and draw wires, fixed to anchorages below two of the pulleys, enable the lantern to be drawn along the span wires so that maintenance can be carried out at the side of the road.



The EDITOR Replies

Our recent reference to the question of a suitable word for the unit of illumination has, so far, prompted only one suggestion. The correspondent who sends us this writes: "If you take the term lumen/sq. ft., abbreviate this to lu/ft.^{2} and omit the diagonal and index figure, you have the word 'luft' (pronounced looft). This is visibly and audibly self-explanatory, and it is also pronounceable in any European tongue."

It may be recalled that a very similar suggestion was put forward in our columns some months ago. The term then proposed was "luf," which is as short as "lux." Earlier still, the word "lume" was suggested, but this is too much like "lumen" and contains no letter which indicates the unit area involved. Readers may well think that "luft" is too suggestive of "Luftwaffe" to be acceptable in this country, but if a word that is more euphonious than "luf" —while being equally suitable—can be found, we hope to hear of it.

A reader asks whether there is any rule concerning the brightness of the lighting units which ought to be used in installations intended to provide very different values of general illumination. We are tempted to reply, "Have you read your I.E.S. Code?" Although the permissible brightness of lighting units rises with the planned general level of illumination (strictly, it depends on the general brightness of the illuminated field), the ratio of light-source brightness and planned illumination should be varied inversely with the illumination level. For instance, the lighting units used for providing 50 lm./ft.^{2} on the horizontal plane can be brighter, though not ten times brighter, than those used for providing 5 lm./ft.^{2}. In the I.E.S. Code the brightness of the lighting units is related to their mounting height as well as to the planned illumination. The rule given in the Code is very simple and easy to apply, but does not, of course, tell the whole story.

The Annual Report of the Chief Inspector of Factories for the year 1947 is quoted on pages 70 and 71. It appears that factory managements have discovered advantages in fluorescent lighting which its suppliers have not yet claimed for it. Its use is favoured, for example, on account of its flexibility and the ease with which it can be moved and installed, while another advantage is that workers cannot remove the reflectors from the lamps—as they sometimes can when tungsten lighting is used—nor can they change the lamps for others which, by projecting beyond the reflector, might cause glare.

While in many factories the lighting has been improved, and it is stated that new factories are generally designed with good artificial lighting systems, the Report gives us a reminder of the indifference or ignorance of some managements. Not infrequently, says the Chief Inspector, typesetting has been found being carried out with an intensity of only 2 or 3 lm./ft^2! It is more than 20 years since the well-known Joint Report of the Industrial Health Research Board and the Illumination Research Committee was published, and in this the inefficiency of typesetting with these low values of illumination was very clearly shown. The independent investigation dealt with in this Report was made with the co-operation of the Federation of Master Printers, and its results were fully reported at the time in the journals of the printing trade—evidently without stimulating some printing office managements to action.

National Illumination Committee of Great Britain

(Affiliated to the International Commission on Illumination)

ANNUAL REPORT FOR THE YEAR 1948

(Approved at the Annual Meeting of the Committee held on Thursday, February 3rd, 1949)

Chief interest during the last year has centred in the meeting of the International Commission on Illumination in Paris, the first to be held since the 1939 meeting in Holland. The meeting took place between June 29 and July 7, and the interest it aroused can be judged from the fact that it was attended by some 400 delegates from 18 different countries; of those present about 60 were from Great Britain, and although slightly less in number than those attending the previous meeting, they again constituted the largest visiting delegation.

The Commission met under the able presidency of Dr. N. A. Halbertsma, of Holland, but it was not possible because of illness for either the Hon. Secretary, the late Sir Clifford Paterson, or the General Secretary, Mr. J. S. Preston, to be present; our chairman was asked to act for both, and Dr. English took over the leadership of the British delegation.

There were technical meetings on 24 different subjects, apart from the opening meeting at the Sorbonne, and three Plenary Sessions. At the technical meetings there were the presentation of Secretariat Reports, five of which came from this country, on the subjects of Light Sources, Traffic Signals, Calculations on Projector Systems, Natural Daylight, and Theatre Stage Lighting; at all meetings, members of the British delegation took an active part in the discussions and in formulating the Recommendations. In addition, three members were asked to preside at appropriate meetings, and there were seven papers presented by delegates from Great Britain.

Most of the technical meetings produced official Recommendations, which in general will serve as a guide for the work of the Commission during the ensuing period. One Recommendation of a general interest concerns the unit of luminous intensity, which in future will be known as the "candela."

As regards future work, it was agreed that the subject of the Classification of Lighting Fittings should be deleted from the programme, whilst those of Architectural Lighting and the Colour of Light Signals should be added. A few changes in Secretariat responsibility were arranged, with the result that the subjects now on the programme of the Commission, together with the corresponding Secretariat countries, are as follows:—

1a	Vocabulary	Switzerland
1b	Definitions and Symbols	France
2+3	Units and Standards of Light	Central Bureau
4	Light and Vision	France
5+6	Visual and Physical Photometry	Switzerland
7	Colorimetry	U.S.A.
21	Light Sources	Great Britain
22a	Diffusing Materials	Czechoslovakia
23a	Street Lighting	U.S.A.
23b	Automobile Lighting	Italy
25a	Museum Lighting	France
25b	Architectural Lighting	Australia
26a	Aviation Ground Lighting	Netherlands
26b	Aircraft Lighting	France
26c	Traffic Signals	Denmark
26d	Calculations on Projector Systems	Great Britain
26e	Colour of Light Signals	U.S.A.
27	Natural Daylight	Sweden
29	Mine Lighting	Belgium
41	Ultra-violet Radiation	Netherlands
62a	Lighting Education	France
62b	Lighting Practice	U.S.A.
62c	Voltage Variations	Italy
62d	Cinema Lighting	Norway
62e	Theatre Stage Lighting	Great Britain

At the concluding meeting, Dr. Halbertsma was re-elected President, whilst M. Folcker (Sweden), M. Leblanc (France), and Dr. Walsh were made Vice-Presidents. Dr. König (Switzerland) was elected to the office of Hon. Treasurer, and Mr. C. A. Atherton to that of Hon. Secretary. This last election means that the Central Bureau will now be situated in the U.S.A. It was arranged that the next meeting should take place in Sweden in 1951.

The French Committee as hosts made excellent arrangements for the meetings and also devised a magnificent programme of technical visits and "divertissements," which was very much appreciated by all who were privileged to take part.

Copies of Volume III of the 1939

(*Continued on page* 82)

Constitution of the National Illumination Committee on December 31st, 1948.

OFFICERS:—

Chairman: DR. J. W. T. WALSH.

Vice-Chairmen: DR. S. ENGLISH and F. C. SMITH.

Hon. Treasurer: E. W. MURRAY, 97, Horseferry Rd., S.W.1.

Hon. Secretary: L. H. MCDERMOTT, Ministry of Works, 57, Onslow Gardens, London, S.W.7.

Representatives of Great Britain on the Executive Committee of the International Commission on Illumination:

DR. S. ENGLISH and F. C. SMITH.

NOMINATED BY THE CONTRIBUTING ASSOCIATIONS:—

Illuminating Engineering Society: DR. J. N. ALDINGTON, P. V. BURNETT, J. G. HOLMES, L. H. MCDERMOTT, J. M. WALDRAM.

Institution of Electrical Engineers: R. O. ACKERLEY, PROF. H. COTTON, C. W. M. PHILLIPS, H. R. RUFF, H. C. SPENCE.

Institution of Gas Engineers: J. B. CARNE, A. G. HIGGINS, W. HODKINSON, P. RICHBELL, F. C. SMITH.

NOMINATED BY THE CO-OPERATING ASSOCIATIONS:—

Admiralty: H. A. L. DAWSON.

Air Ministry: C. HEYES, AIR CDR. N. H. D'AETH, W/Cdr. R. E. DRAKE.

Association of Public Lighting Engineers: N. BOYDELL.

British Electrical and Allied Manufacturers' Association: J. M. H. STUBBS.

British Electrical Development Association: V. W. DALE.

British Gas Council: A. M. BELL, D. CHANDLER.

Department of Scientific and Industrial Research: (*National Physical Laboratory*) DR. L. A. SAYCE, DR. J. W. T. WALSH; (*Building Research Station*) W. ALLEN.

Electrical Contractors' Association: C. J. VENESS.

Electric Light Fittings Association: G. CAMPBELL, W. E. J. DRAKE.

Electric Lamp Manufacturers' Association: W. J. JONES, E. B. SAWYER.

Glass Manufacturers' Federation: DR. W. M. HAMPTON, G. MARCHAND.

Incorporated Municipal Electrical Association: R. BIRT.

Industrial Health Research Board: H. C. WESTON.

Institution of Municipal Engineers: C. HARPER.

Medical Research Council: PROF. H. HARTRIDGE.

Ministry of Civil Aviation: R. BROADBENT, F. C. PETTS.

Ministry of Health: A. SCOTT.

Ministry of Labour and National Service: E. W. MURRAY.

Ministry of Supply: E. S. CALVERT, BRIG. F. H. MACLENNAN, J. L. RUSSELL.

Ministry of Transport: DR. H. F. GILLBE.

Ministry of Works: G. SMITH.

Post Office: DR. C. G. ROBERTS, W. T. GEMMELL.

Railway and London Transport Executives: A. CUNNINGTON, E. MORGAN.

Society of British Gas Industries: W. R. EDGAR, R. J. ROGERS, P. C. SUGG.

Society of Glass Technology: DR. S. ENGLISH.

(*Continued from page* 80)

Proceedings have now been received and distributed to members and University Libraries. This volume contains the Recommendations and the minutes of the Plenary Sessions and the technical meetings.

During the year the Committee lost by death two of its well-known members in the persons of Sir Clifford Paterson and Mr. J. S. Dow. Sir Clifford was one of the original members of the Committee and was present at the first meeting in December, 1913; he became a Vice-Chairman in 1920 and the Hon. Treasurer in 1943. Mr. Dow had been a member since 1927. Various other changes have taken place in membership, and these are shown in the table below; it should be mentioned, however, that the Committee has suffered a further loss by the fact that Prof. MacGregor-Morris, who was also present at the first meeting, is now no longer a member.

Certain changes have also been made in the officers of the Committee, and Dr. English has now become one of the two Vice-Chairmen and also one of the representatives on the Executive Committee of the International Commission. Mr. E. W. Murray has been elected to the office of Hon. Treasurer.

The grateful thanks of the Committee are due to the British Standards Institution, who gave valuable help in the work on certain subjects, in particular being responsible for the preparation of two of the Secretariat Reports.

The following information regarding British Standards dealing with Illumination will be of interest. New Standards issued: B.S.1381: 1947—Gas lighting units and fittings for single family dwellings, and B.S. E.19: 1948—Aircraft lamps; Standards revised: B.S. 398: 1948—Classification of symmetrical light distributions from lighting fittings, and B.S. 710: 1948—Electric reading lamps; amendments issued: P.D. 734—Amendment No. 1 to B.S. 1050: 1945—Visual indicator lamps, P.D. 768—Amendment No. 4 to B.S. 555: 1939—Tungsten filament electric lamps other than general service, and P.D. 853—Amendment No. 7 to B.S. 161: 1940—Tungsten filament general service electric lamps.

J. W. T. WALSH,
Chairman.

ORGANISATION	REPRESENTATION Dec., 1947	Dec., 1948
Illuminating Engineering Society	L. J. Davies	Dr. J. N. Aldington
	J. S. Dow	J. G. Holmes
Institution of Electrical Engineers	Dr. J. H. Nelson	J. M. Waldram
	P. Good	Prof. H. Cotton
	Prof. MacGregor-Morris	C. W. M. Phillips
	Sir C. Paterson	H. R. Ruff
Institution of Gas Engineers	J. W. Townley	H. C. Spence
	A. M. Bell,	J. B. Carne
	J. E. Davis	P. Richbell
Air Ministry	Air/Cdre G. I. L. Saye	Air/Cdre N. H. D'Aeth
		W/Cdr. R. E. Drake
Association of Public Lighting Engineers	E. J. Stewart	N. Boydell
British Electrical and Allied Manufacturers Association	**C. Rodgers**	J. M. H. Stubbs
Dept. of Scientific and Industrial Research (National Physical Lab.)	T. Smith	Dr. L. A. Sayce
Electric Light Fittings Association	Dr. S. English	W. E. J. Drake
Institution of Municipal Engineers	**E. J. Efford**	C. Harper
Ministry of Civil Aviation	R. J. Broughton	R. Broadbent
	D. Parker	F. C. Petts
Ministry of Supply		E. S. Calvert
		J. L. Russell

SITUATIONS VACANT

DRAWING OFFICE ASSISTANT (young) required in Lighting Fittings Design Dept., by E.L.M.A. Company, London. Applicant must have ability for designing and good standard of technical education. Write, stating age, experience, and salary required, to Box No. 790, LIGHT AND LIGHTING, 32, Victoria-street, London, S.W.1.

DRAUGHTSMEN. Two wanted for fitting design by well-known firm of Lighting Engineers in London. Apply, stating age, qualifications, experience, and salary, to Box No. 791, LIGHT AND LIGHTING, 32, Victoria-street, London, S.W.1.

SITUATION WANTED

REGISTERED LIGHTING ENGINEER (I.E.S.), 38, wide experience in industrial, commercial, and street lighting, seeks change of situation. South preferred. Overseas offers would be considered. Write Box "D," LIGHT AND LIGHTING, 32, Victoria-street, London, S.W.1.